

SECTION 401

PLANT MIX PAVEMENT

401.01 DESCRIPTION

This work is the production and placing of plant mix asphalt pavements.

Plant mix pavement is one or more courses of plant mixed aggregate, mineral filler or chemical additive when required, and bituminous material, constructed on a prepared foundation.

401.02 MATERIALS

401.02.1 Aggregate

Use aggregate sources meeting Section 106 requirements. Produce aggregate meeting Section 701 requirements.

401.02.2 Bitumen

Furnish bitumen meeting Section 702 and the contract requirements.

401.02.3 Blending Material

Blending material is selected natural or crushed mineral aggregate.

Do not use pit strippings, overburden, or other deleterious material as blending material.

Furnish blending material with a volume swell not exceeding 8 percent and not displaying cracking or disintegration when tested under MT-305.

401.02.4 Mineral Filler

Furnish mineral filler meeting Subsection 713.06 requirements.

The mineral filler quantity and type is determined by tests made with mineral fillers in the crushed aggregate for plant mix bituminous material.

401.02.5 Additives

A. Hydrated Lime. Furnish hydrated lime meeting Subsection 713.02 requirements.

Hydrated lime introduced into a paving mixture, in a blend box with asphalt cement, is a chemical additive and is not included in gradation test results.

B. Anti-stripping Additive. Furnish anti-stripping additives meeting the contract requirements.

The percentage of anti-stripping additive is determined by laboratory tests on samples of the aggregate proposed for use. The anti-stripping additive must be uniformly distributed throughout the bituminous material at the refinery.

The anti-stripping quantity may be increased or decreased by the Engineer.

401.03 CONSTRUCTION REQUIREMENTS

401.03.1 Composition of Mixtures

A. Job Mix Formula - Design. Develop and submit for approval, a proposed job mix target aggregate gradation for each grade of pavement mix to be produced. Establish a single target value for each specified aggregate size within the job mix target limits in Table 701-15 of Subsection 701.03. The job mix tolerances will be applied to the approved target values. Submit the proposed job mix formula on Form CB-30 QA before submitting the mix design samples.

Furnish aggregate samples, witnessed by the Department, representing total production at least 20 days before mixing operations. The Department will establish for

each mixture a design mix formula providing the approved job-mix aggregate gradation, a recommended asphalt content, and the types and quantities of additives, if required.

Produce aggregates meeting the approved job mix aggregate gradation.

This procedure is repeated if there is a change in the aggregate properties or a change in the materials source.

- B. Job Mix Formula - Field Established.** A job mix formula for each grade of bituminous mix is established in the field for each design mix formula.

The Engineer will establish a target asphalt content expressed as a percentage of the total mix weight. The target asphalt content is based on design and field Marshall mix test results. The target asphalt content may be adjusted to improve mix properties as measured by field Marshall tests. Maintain the actual asphalt content in the mix within plus or minus 0.3 percent of the target asphalt content.

Use the approved job mix aggregate gradation unless otherwise directed.

- C. Aggregate Sampling and Acceptance.** Aggregate is accepted in the stockpiles for physical properties, excluding combined gradation.

Take samples, witnessed by the Department, for aggregate gradation acceptance testing, just before the bitumen is added to the mix.

When aggregate gradation is controlled by a cold feed control system without plant screens, acceptance-testing samples may be taken from the cold feed. Cold feeds for batch plants will not be sampled for acceptance testing when plant screens are used.

401.03.2 Equipment

- A. All Mixing Plants.** Furnish bituminous mixing plants meeting the following requirements. Scale requirements apply only where proportioning by weight is required. Cold feed control requirements apply only where aggregate gradation is controlled by a cold feed control system.

- 1. General.** Use mixing plants of the weight-batching, continuous-flow, or dryer drum type.

Do not use mixing plants that cannot produce a uniform mix meeting the contract requirements.

- 2. Storage and Heating Equipment.** Use bitumen storage tanks that uniformly heat and maintain the tank contents at the required temperatures.

Do not allow fuel oil or other material to contaminate the bitumen.

Equip storage tanks with a gauge, calibrated rod, or float that accurately measures the contents.

- 3. Aggregate Feeder.** Equip plants with an accurate, mechanical aggregate feed system.

- 4. Bins.** Provide easy and safe access to bins and bin sampling areas. Provide separate, dry storage for the mineral filler.

- 5. Bituminous Control Unit.** Use weighing or metering devices to control the bituminous material introduced into the mix within the specified limits.

Measure the bitumen discharged into the mixer by a temperature-compensating meter with totalizer.

- 6. Thermometric Equipment.** Install an armored thermometer or other approved thermometric device in the bituminous material feed line near the charging valve at the mixer.

Use thermometric equipment having an accuracy of plus or minus 5 °F (3 °C), sensitive to a minimum temperature rate change of 10 °F (5.5 °C) per minute.

- 7. Emission Control.** Furnish emission control devices meeting the Department of Health and Environmental Sciences requirements.

Do not discharge wet scrubber effluent into a live stream, lake, or pond. Circulate the effluent through sludge pits or tanks. Contain and dispose of the sedimentation, and all other wastes produced by crushing and mixing operations under Subsection 106.02.5.

Do not return the material collected from air pollution control equipment (bag house fines) to the mix unless authorized in writing. Authorization may be terminated when test results indicate any mix property is outside the specified limits. When authorized, return bag house fines to the mix where the asphalt is introduced, using equipment to meter and uniformly add as a percentage of the total aggregate as established by the Engineer.

- 8. Scales for Hauling Units.** Furnish haul unit scales meeting Subsection 301.03.2(C) requirements.

- 9. Plant Scales.** Obtain the Engineer's approval for all weighing equipment. Use adjustable weigh equipment accurate to within 0.5 percent of the true weight throughout the use range.

Have available at least ten 50-pound (22.7 kg) weights for scale testing. Have scales inspected and sealed when requested.

Use beam scales with a telltale indicator for each size aggregate and a tare beam for balancing the hopper. The telltale indicator must begin moving when the weight is within 100 pounds (45.4 kg) of the desired weight. Poises must lock in any position and prevent unauthorized change.

Use vibration-free springless dial scales with dial numerals legible from a distance of at least 10 feet (3 m). The dial must be a compounding type with a full complement of index points and be in plain view of the operator. Pointers causing parallax errors cannot be used.

Replace scales failing to maintain positive adjustment.

10. Weigh System.

- a. Automatic Weighing.** Plant mix bituminous mixtures may be weighed with an automatic digital weigh system. Assure weigh accuracy to within plus or minus 0.5 percent of the true weight throughout the use range.

Include in the system an automatic printer that provides the following information:

- 1) Project No. (as shown on plans);
- 2) Item Name (as shown on detail estimate);
- 3) Date;
- 4) Time;
- 5) Ticket Number (consecutive);
- 6) Haul Unit No.;
- 7) Net tons (metric tons) in load, to nearest 0.05 ton (0.05 metric ton);
- 8) A subtotal of tons (metric tons) for each haul unit since the beginning of the shift; and
- 9) An accumulated total for all haul units since the beginning of the shift.

Use a pre-programmed printer or one equipped to prevent manual override of any weight information. Have the weigh system tested, certified, and sealed by the State Bureau of Weights and Measures after each plant move and before production for a project. Immediately stop production should the printer malfunction or breakdown and do not resume until corrected. Delivery of material

from storage or surge bins will be permitted only if the weight can be maintained within weigh specifications.

The Project Manager will randomly designate the re-weighing of loaded vehicles, at least 3 times per project, on an independent certified scale if one is within a 20 mile (32 km) round trip distance from either end of the project.

Re-test the plant weigh system any time the difference between the re-check and the plant system exceeds plus or minus 1 1/2 percent of the load. Any weight difference will be treated under Subsection 109.01.1.

- b. Manual Weighing.** The contractor may manual weigh and record weights instead of using an automatic digital weigh system. Manual weighing must include platform scales as specified in Subsection 301.03.2(C) and a competent weigh person and dump person.

Direct the weigh person to record, on Department furnished forms, weights to the nearest 100 pounds (45.4 kilograms) as well as other required information regarding delivery and placement.

Tabulate and furnish a machine tape for the total of the weighed material delivered and placed on the roadway each shift. Certify that weights and totals furnished are a true and correct record of materials delivered and placed in the work. Deliver the records and totals before 10:00 a.m. the next working day following the shift.

The Project Manager will randomly designate the re-weighing of loaded vehicles to verify the recorded weight at least once each day. Weight differences are treated under Subsection 109.01.1. Submit trucks weighing on platform scales for random taring at least twice each day.

- 11. Safety Requirements.** Install and maintain stairs, ladders, walkways, and all other plant facilities meeting state and federal safety requirements.

Provide access to the tops of truck bodies for taking samples and mix temperature data.

Maintain a safe and unobstructed route in and around the truck loading area.

- 12. Cold Feed Control.** Aggregate gradation may be controlled by a cold feed control system permitting hot mix plant operation without plant screens, excluding a scalping screen.

Feed each aggregate stockpile through a separate bin having a positive feed that can be accurately calibrated. Use a quick adjusting feed that maintains a constant, uniform flow throughout its calibration range.

Re-combine the aggregate in the mix design proportions in the cold feed process before it enters the dryer.

Batch and continuous flow plants operating without cold feed controls must have enough bins to store aggregate and permit recombining of the aggregate in the required proportions.

- 13. Burner Fuel Restrictions.** Approved fuels to heat and dry aggregates are as follows:

- Propane;
- Butane;
- Natural Gas;
- Fuel Oil (grades 1 and 2 only); and
- Coal.

EPA Specification - Used Oil Fuel (EPA-UOF) may be used instead of the approved burner fuels provided the Table 401-1 requirements are met.

TABLE 401-1
EPA SPECIFICATION - USED OIL FUEL REQUIREMENTS

PHYSICAL PROPERTIES	
Property	Range
API Gravity	20-28
Viscosity at 122 °F (60 °C) (Saybolt Flurol)	10-20
Pour Point °F (°C)	+10 (-12)
Flash Point, min. °F (°C)	100 (37.8)
Water by Distillation %	Under 1
Solids by Separation %	Under 1
Ash %	Under 0.4
Sulfur	Average 0.5%
Kinematic Viscosity at 100 °F (37.8 °C) (centistokes)	54-100
Kinematic Viscosity at 122 °F (60 °C) (centistokes)	15-75
CHEMICAL PROPERTIES	
Element or Compound	Permitted Level
Vanadium	Under 100 ppm (100 mg/L)
Cadmium	Under 2 ppm (2 mg/L)
Chromium	Under 10 ppm (10 mg/L)
Lead	Under 100 ppm (100 mg/L)
Arsenic	Under 5 ppm (5 mg/L)
Total Halogens	Under 1,000 ppm (1,000 mg/L)
PCB's	Under 2 ppm (2 mg/L)

Notify the engineer in writing at least 48 hours before using EPA-UOF. Furnish a copy of the most current tests certified by the supplier and showing compliance with physical and chemical requirements with the notice. Also certify that the plant burner is designed and equipped to properly preheat and burn EPA-UOF. The right to sample and test to verify certified test results is reserved.

Immediately stop using EPA-UOF fuel if burner flame-outs or other evidence of incomplete combustion or mix contamination are evident. Begin using one of the other approved fuels to complete the work. No claim for additional compensation will be considered or allowed.

B. Batching Plant.

- 1. Dryer.** Furnish plants having a dryer or dryers that continuously agitate the aggregate while heating and drying.

Equip the dryer with a mercury-actuated thermometer, an electric pyrometer, or other approved thermometric instrument with a dial scale. Locate the thermometer at the dryer discharge chute so it automatically registers the heated aggregate temperature.

Fully enclose the material transfer or conveyance from the dryer to the mixer.

- 2. Screens.** Use plant screens that have a storage capacity exceeding the mixing units full capacity.
- 3. Bituminous Control.** Assure the bituminous measuring equipment is accurate to within plus or minus 0.3 percent of the true measure.

Equip the plant with a heated, quick-acting, no-drip charging valve located directly over the bituminous material bucket. The bucket must deliver the heated bitumen in a thin, uniform sheet or in multiple streams over the mixing units full width.

4. **Mixer Unit.** Use a mixer capable of producing a uniform mixture within the job-mix tolerances.

Enclose or hood the mixer box to prevent dust loss.

Equip the mixer box with a lock-timing device that controls the mixing cycle.

5. **Aggregate Sampling Device.** Provide a sampling device that samples dried aggregate when the plant is operated with plant screens.

When cold feed controls are used, provide a sampling device for taking a composite sample at a point just before the aggregate enters the dryer.

Maintain a constant aggregate feed rate when samples are taken.

Split the sampled material to the size specified in MT 202.

C. Continuous Mixing Plant.

1. **Aggregate Control.** Assure the cutoff system automatically stops mixing when the minimum bin level is reached. Equip each bin with an overflow to control the top aggregate level.

Equip the plant with bypass gates for collecting individual box test samples for calibrating gate openings.

Provide a platform scale with a 500-pound (227 kg) capacity and containers for weighing test samples.

2. **Dryer.** Furnish a dryer meeting Subsection 401.03.2(B)(1) requirements.
3. **Screens.** Furnish screens meeting Subsection 401.03.2(B)(2) requirements.
4. **Bituminous Control.** Use a rotating, positive-displacement volumetric proportioning bituminous metering pump with nozzles at the mixing unit. The pump operating capacity must be synchronized with the aggregate flow to the mixing unit by a positive, automatic, adjustable interlocking control. Provide equipment for accurately checking the bitumen flow rate into the mix.
5. **Mixing Unit.** Equip the plant with a continuous mixer to produce a uniform mix within the job-mix tolerances.

The units paddles must be adjustable and reversible to retard the mix flow.

Assure the mixer has the manufacturer's plate stating the mixer's net volumetric content at the heights inscribed on a permanent gauge. Provide charts showing the aggregate feed rate per minute for the aggregate being used.

Equip the discharge hopper with dump gates that permit rapid and complete mix discharge.

6. **Aggregate Sampling Device.** Furnish an aggregate sampling device meeting Subsection 401.03.2(B)(5) requirements.

D. Dryer Drum Mixing Plant.

1. **Cold Feed Control.** Furnish a feed control meeting Subsection 401.03.2(A)(12) requirements.
2. **Calibrated Cold Feed Proportioning.** Calibrate the cold feed to provide full mix gradation control.
3. **Weight Measurement of Aggregate.** Positive weight measurement of the combined cold feed must regulate the feed gate and permit automatic correction for load variations.
4. **Synchronization of Aggregate Feed and Bituminous Material Feed.** Synchronize the bituminous feed control with the total aggregate weight-measurement device to

provide a uniform asphalt percentage in the mix. It must automatically compensate for weight variations in the cold feed coupled with the aggregate moisture content.

5. **Aggregate Sampling Device.** Provide a sampling device that will take a composite sample just before the aggregate enters the dryer drum mixer.

Maintain the aggregate feed rate during sampling. Split the sampled material to between 30 (13.6 kg) and 50 pounds (22.7 kg).

6. **Hydrated Lime or Mineral Filler Feed System.** Introduce dry hydrated lime and mineral filler into drum dryer mixing plants just below the asphalt introduction point.

The system must provide positive, accurate material feed and be automatically synchronized to the aggregate feed. The system must indicate the weight entering the mixing unit on a time-coordinated basis.

Weigh using an automatic indicating electronic system. The lime or mineral filler may be weighed directly, or the storage container including lime or mineral filler may be weighed.

Provide a continuous digital readout showing the weight or rate of feed in tons (metric tons) per hour. Record the information using a production monitor/recorder system or by a de-cumulating balance ticket printing system. Record the information at minimum five-minute intervals or as directed.

Silo or storage container system weights will not be used for acceptance during filling or transfer. Limit filling or transfer periods to 1 hour per 3 hours of plant operation. Record and provide start and finish times for filling or transfer and the total quantity added.

Suspend mixing for erratic feeding or failure to feed hydrated lime or mineral filler to within 20 percent of the job mix formula. Do not resume until corrected or repaired.

7. **Flow Rate Meter.** Measure the asphalt cement discharged into the mixing unit using a flow rate meter with totalizer and temperature compensation.

The totalizer is to record 1,000,000 gallons (3,785,000 L) and be certified to a plus or minus 0.20 percent of the measured quantity.

Use a flow rate meter and totalizer that automatically corrects to a temperature of 60 °F (16 °C) with an operating range of +60 °F (16 °C) to +450 °F (232 °C).

Locate the totalizer readout in the plant control room so it is readily accessible to the Inspector.

The flow rate meter must automatically shut off any time asphalt is diverted or stops entering the mixing unit.

Calibrate the flow rate meter and totalizer before the start of the project and as necessary during production. The Project Manager will witness the calibration.

Provide the equipment and assistance for initial and subsequent calibration checks and furnish a copy of all calibration checks.

Use a calibration volume of at least 3,000 gallons (11,355 L). Use weigh scales that have been tested and certified.

Furnish a test report showing the asphalt's specific gravity.

Spot check failure will require re-testing and certification above. The Project Manager will establish the spot check interval.

8. **Production Monitor - Recorder.** Use recording equipment that automatically monitors and records on a time coordinated basis, the aggregate, lime or mineral filler, and asphalt weight entering the mixing unit. The records may be continuous (chart recorder) or digital printout.

Chart recorders must clearly record asphalt content changes of 0.1 percent or more and aggregate feed rate changes of 1.5 percent or more.

Digital printout equipment must record the day's total production at minimum five-minute intervals, or the interval directed by the Project Manager.

Digitally display the aggregate and asphalt rates in tons (metric tons) per hour and daily totals. Display lime or mineral filler by tons (metric tons) per hour or on a de-cumulating balance.

The monitor system must operate on unprocessed signals from measuring devices.

Provide continuous access to the recorder during production.

Submit the permanent record.

Failure to maintain asphalt content within the specified tolerance is grounds to suspend production until corrected. This provision does not apply to the first 15 minutes after each day's first start-up.

Operate the production/monitor recorder at all times during production. Stop production when the recorder is not operational.

E. Storage and Surge Bins.

1. **General.** Hot bituminous mix storage or surge bins may be used for balancing production capacity with hauling and placing capacity.

Discontinue use of hot mix storage or surge bins that cause segregation, adverse mix heat loss, or adversely affect the bituminous mix quality.

Dispose of all rejected mix at Contractor expense.

2. **Low-level Indicator.** Equip storage or surge bins with an automatic low-level indicator that signals when the mix level drops below the discharge cone or the minimum level specified by the manufacturer.

Mix discharge during low level indication is permitted for emptying the bin at the end of shifts.

3. **Loading and Unloading.** Equip storage or surge bins with a batch hopper or rotating chute to reduce segregation during loading. The batch hopper gates must be interlocked with the mix discharge gates to keep the batch gates closed during mix discharge. Suspend production for equipment failure or improper operation.
4. **Storage Time.** The Project Manager will establish the maximum bin storage time.

Initially, a maximum bin storage time of two hours without discharge is permitted until data and experience is available to establish the maximum permissible storage time.

Empty all bins each day at the close of work.

F. Roadway Equipment.

1. **Pavers.** Spread plant mix pavement, shape, and finish using one or more self-contained, self-propelled pavers operated without supplemental spreading, shaping, or finishing equipment to produce the specified work.

Equip pavers with an integral activated screed or strike-off assembly, heated if necessary.

Spread and finish the surfacing course to at least a full lane width and from 3/4 to 6 inches (19 mm to 150 mm) in depth.

Use extension and cut-off shoes in minimum 1-foot (305 mm) increments. Screed extensions must have an equal length of auger extension.

The screed or strike-off assembly must not tear, shove, or gouge the paved surface.

Equip pavers to automatically control the transverse slope and screed elevation using a sensing device at either side of the paver, receiving grade information from an independent grade-line control or the midpoint of a mobile grade reference.

Mount the sensing unit to receive grade information at 15 to 50 percent of the length of the leveling arm ahead of the screed. Furnish a commercially manufactured mobile grade reference recommended by the paver manufacturer.

Use a mobile grade reference device at least 40 feet (12.2 m) long to place the first lane or strip of each plant mix pavement lift. The remaining lanes or strips of each pavement lift may be placed with a mobile grade reference with an effective length of at least 10 feet (3 m), with an adjacent lane or pavement strip as the gradeline reference.

Maintain the transverse slope at all times and have controls to adjust the slope throughout super-elevated curves.

If the automatic controls fail, paving may be finished, not to exceed four hours, using manual controls, if the specifications can be met. Repair the automatic controls before starting the next paving shift. Automatic controls may be waived on irregular sections.

Provide an attachment for forming beveled edges on surfacing courses when required.

Pavers must be able to ascend a seven percent grade while pushing a loaded truck, have quick, positive steering and operate at speeds commensurate with the mix delivery rate to allow uniform placement and prevent interrupted paver operation.

The plant mix material may be dumped directly into the paver hopper or windrowed ahead of the paver.

The paver hopper capacity must permit the paver to maintain its speed while receiving loads.

2. **Trucks.** Truck haul beds must be tight, clean, smooth and free of cleaning agents before hauling material.

Do not use trucks that cause segregation, delays, or have oil leaks.

When directed, cover each load with canvas or other approved material to protect the mix.

3. **Rollers.** Furnish rollers equipped with drum cleaning devices and a watering system that evenly wets the roller surface.

Do not use steel rollers having flat spots, grooves, or projections that mar or injure the pavement surface.

Remove rollers that crush the paving aggregates.

401.03.3 Aggregate Production, Testing, and Acceptance

- A. **General.** Furnish aggregates meeting the approved job mix target values within tolerances at the point of bituminizing.

Be responsible for all sampling, testing and controlling aggregate gradations, mechanical fracture, and volume swell during aggregate production. Establish a quality control plan using generally recognized procedures.

- B. **Acceptance Sampling and Testing.** Acceptance sampling will be by Subsection 401.03.1(C).

1. **Mechanical Fracture and Volume Swell.** Mechanical fracture tests will be by MT-217. Volume swell tests will be by MT-305.

2. **Aggregate Gradation.** The Project Manager will randomly select gradation test samples.

The approximate quantity represented by each sample is 600 tons (600 mt). Additional samples may be selected and tested at the Project Manager's discretion.

The quantity represented by five samples or approximately 3000 tons (3000 mt) constitutes a lot whenever production schedules and material continuity permit. The Project Manager may establish a lot quantity represented by three to seven consecutive random samples when there are short production runs, significant material changes, or other unusual characteristics of the work.

Gradation tests are by MT-202.

C. Acceptance.

1. **Fracture and Volume Swell Requirements.** The aggregate will be evaluated for mechanical fracture and volume swell requirements using the test results taken on samples selected by the Project Manager.

Results are acceptable if the average of all tests is within the specified limits and not more than one test out of any five consecutive tests is outside these limits.

Do not begin plant mix operations until stockpiled aggregates meet these requirements.

2. **Gradation Requirements.** Plant mix pavement is evaluated for gradation requirements on a lot-by-lot basis. Acceptance is made under Subsection 105.03.2

401.03.4 Preparation of Aggregate

- A. General.** Have enough material stockpiled for at least one day of plant mix operations.

Do not charge the mixing plant with aggregates directly from crushing or screening plants or a combination of these plants.

Proportion and uniformly blend blending material (not mineral filler), when required, with the aggregate.

- B. Batch and Continuous Flow Plants.** Dry and heat aggregates in the dryer within the mix design temperature range.

The aggregate temperature, when introduced into the mixing unit, must not exceed 325 °F (163 °C).

Adjust flames for drying and heating to prevent aggregate damage and not leave visible unburned oil or carbon residue on the aggregate.

If the bituminized mixture shows excess moisture, such as foaming on the coarse aggregate, excessive mix slumping in the truck, condensed water dripping from the truck box, bubbles or blisters forming on the surface immediately behind the paver, or any other visual indications, make adjustments to lower the moisture content.

401.03.5 Preparation of Bituminous Mixture

- A. All Plants.** Store mineral filler or hydrated lime in a separate bin and feed directly into the mixing unit or weigh box. Use a uniform feed rate.

If mineral filler is not weighed with the other aggregates in the weigh box at the mixing plant, determine the mineral filler proportion on a weight basis, measured separately from the other aggregates. After the mineral filler proportions have been determined, the material may be added to the mix by volume or weight measurement.

Mix to produce a homogeneous mixture. Assure all aggregates are thoroughly and uniformly coated with bitumen.

Remove, dispose of, and replace any mix that is damaged by burning, improper mixing, or not meeting specifications at Contractor expense.

Maintain the bituminous mix discharge temperature between the specified lower mixing temperature and the greater of:

- 1 The upper mix design temperature; or
2. 325 °F (163 °C).

The discharge temperature will be periodically checked and recorded. Maintain a discharge temperature within plus or minus 10 °F (5.5 °C) of the specified temperature.

The average of any three checks must be within the specified limits.

Suspend plant operations when mix temperatures exceed these limits.

B. Batch and Continuous Flow Plants.

1. General. Measure and convey the hot aggregate into the mixing unit meeting the specified gradation. Introduce the aggregate at a temperature:

- a. Not to exceed 225 °F (107 °C) when cutback liquid asphalt is used; or
- b. Not to exceed 325 °F (163 °C) when asphalt cement or slow-curing liquid asphalt is used.

Do not introduce asphalt into the mixing unit at 25 °F (14 °C) or more below the aggregate temperature.

Assure the bituminous mix is within the specified temperature range in the data on "temperature-viscosity", furnished for the bituminous material used.

2. Mixing Time. Mix for at least 25 seconds or the time specified by the Project Manager. Mixing time, in seconds, for continuous flow plants equals "pugmill dead capacity in pounds (kilograms)" divided by "pugmill output in pounds (kilograms) per second".

401.03.6 Surface Conditions, Weather Limitations, and Paving Dates

Stop plant mix paving when the surface temperature is less than 35 °F (2 °C), the surface is wet, the roadbed is unstable, or the Project Manager determines adverse weather conditions prevent the proper handling, finishing, or compacting of the mix. Suspend all paving work by November 1st.

Complete all sections of plant mix pavement, to be open to traffic during winter suspension, to the full plan width and thickness, excluding seal coating. Complete this work meeting the contract requirements before the November 1st paving cessation date.

The Project Manager will suspend time assessment between November 1st and November 16th when the next scheduled significant work item is paving and all grading, gravel and other operations affecting the safe and convenient use of the roadway by the traveling public are complete.

Submit a written request to the Engineer and obtain written approval to pave after November 1st.

Plant mix surfacing placed after November 1st and before April 15th is at the Contractor's risk and subject to the following conditions.

1. The surface temperature to be paved is at least 35 °F (2 °C), measured by the Project Manager.
2. All applicable specifications are met.
3. Make permanent repairs and restore partially completed pavement to the required profile, section, and condition at Contractor expense before placing any remaining lifts.
4. This is not a waiver by the Department of any other contract requirement regarding the work sequence or traffic operation.

If the paving operation causes transverse joints spaced at less than one half mile (805 m), suspend paving work until the next April 15.

No payment is made for the plant mix or asphalt on progress estimates between November 1st and April 15th for partial width or thickness. Promptly repair damage to all partial width or thickness of plant mix surfacing used by traffic during this period for any reason including suspension of work due to adverse weather.

Provide all required interim traffic striping and traffic control on partially completed pavement at Contractor expense.

Failure to promptly make repairs and provide interim striping and traffic control is cause for the Department to perform or have the work performed and deduct the cost from monies due or that may become due the Contractor.

Payment for partial width or thickness pavement in acceptable condition will be made on the estimates following the end of the period on the next April 15th.

These requirements apply when the Project Manager gives written approval to the Contractors request that a portion of the planned width or thickness be placed between November 1st and April 15th of the next year.

401.03.7 Existing Surface Preparation

Perform existing surface preparation meeting Section 204 requirements.

401.03.8 Prime and Tack Coat

Apply prime and tack coat meeting the applicable requirements of Sections 407 and 410 and the contract.

Apply prime coat as directed before placing the plant mix.

Allow the prime coat to cure at least 24 hours before placing the plant mix unless otherwise approved.

Do not place plant mix on any primed surface containing free moisture, as determined by the Project Manager.

Apply tack coat on existing pavement to be overlaid and between lifts when plant mix pavement is constructed in multiple lifts.

401.03.9 Protection of Traffic and Roadway Structures

A. Traffic Protection. Place traffic control devices meeting Section 618 requirements, and the approved traffic control plan.

At the end of each day's work, and when not in use, park all equipment at least 30 feet (9.2 m) from the outside edges of the traveled lane.

B. Protection of Roadway Structures. Protect roadway structures meeting Subsection 410.03.9 requirements.

401.03.10 Spreading and Finishing

Place and spread the mix to the widest practical width on the approved surface. Place shoulder-widening material with approved equipment.

Transport and place the bituminous mix with the least possible segregation. Remove and replace segregated pavement areas behind the paver with specification material before initial rolling begins. Correct all segregated areas at Contractor expense.

Place plant mix surfacing in compacted lifts not exceeding 0.20 feet (60 mm) thick; plant mix bituminous base in compacted lifts not exceeding 0.35 feet (110 mm); and plant mix base riding course not exceeding 0.25 feet (75 mm) thick.

Establish and maintain horizontal line control for paving. The Engineer will furnish the Contractor the necessary survey notes to establish these controls. Maintain the paving control line tolerance within 0.25 foot (75 millimeters) of a true line from the existing reference points using standard surveying practices.

Failure to maintain the paver control line within the specified tolerance is cause for corrective action or pavement removal and replacement, as directed by the Engineer, at Contractor expense.

Include the cost of furnishing horizontal line control in the plant mix pavement bid item.

Set a string line using the alignment control to establish one edge of the first lane of each surfacing lift. Remove all string line used for the final lift after use.

On small or irregular areas, approaches, turnouts, around manholes, inlets, walls, and on other areas not readily accessible to a paver, plant mix material may be spread to the specified thickness by special pavers or other approved methods. Compact these areas as directed.

Place plant mix pavement at bridge ends using wire line grade control meeting the applicable requirements of Subsection 411.03.5.

Non-Interstate two lane plant mix pavements may be opened to traffic or to haul units when the mat is compacted and cooled.

Four lane routes may be opened to traffic and haul units when the mat is compacted and the surface cools to 140 °F (60 °C).

401.03.11 Constructing Joints

Continuously place each lift and provide at least a 6-inch (150 mm) offset between longitudinal joints in successive lifts. Offset transverse joints in successive lifts by at least 6 feet (1.8 m).

Correct joints not meeting the surface tolerance requirements to Subsection 401.03.14 requirements.

Uniformly coat the exposed face of all joints, excluding those formed by echelon paving, with SS-1 emulsified asphalt or other approved bitumen just before placing the abutting course.

Construct longitudinal joints in the top lift of plant mix at the centerline or lane line. If these locations are not practical, construct the joint outside the wheel paths.

Construct a vertical transverse joint the full lift depth if the mix cools below 175 °F (80 °C) before placing additional mix. Remove loose material, brush the joint face with asphalt, and compact the fresh mix against the joint face when paving is resumed.

Bevel the paving lift ends on roadways under traffic at a 20:1 ratio. When paving of the lift resumes, construct transverse joints.

When the compacted thickness exceeds 3/4-inch (19 mm), taper longitudinal joints with a 5:1 slope or flatter. Do not permit an exposed longitudinal joint length to exceed one day's paving run. Compact the joint to a minimum 95 percent of Marshall density.

Sign the new pavement end at the close of work each day meeting the traffic control plan and contract.

Construct joints at bridge ends or other rigid structures after the existing base is prepared and compacted. Apply a coat of SS-1 emulsified asphalt to portions of structures abutting the plant mix pavement.

401.03.12 Compaction, Compaction Control Testing, and Acceptance Testing

A. Compaction. Once the plant mix is spread, struck off, and surface irregularities are corrected, compact the plant mix to at least 95 percent of the established target density. Compact and finish without displacing, over-compacting, cracking, or shoving.

Complete compaction rolling before the mat temperature falls below 175 °F (80 °C). Compaction rolling after the temperature is below 175 °F (80 °C) is cause to suspend paving operations. Compaction rolling is rolling in the vibratory mode. The Project Manager may increase the minimum 175 °F (80 °C) temperature when compaction rolling damages the new pavement.

Begin finish rolling immediately after compaction rolling and continue until roller marks are eliminated. Complete finish rolling the same day the mix is placed.

Correct any pavement displaced due to roller direction changes or other causes before final compaction.

Remove and replace any mix that is segregated, loose and broken, mixed with dirt, or is defective with fresh hot mix and compact at Contractor expense.

- B. Leveling, Patching, and Thin Lifts.** Subsection 401.03.12(A) does not apply to initial plant mix lifts used for leveling ruts, sags, or other existing surface defects that are less than 0.10 foot (30 mm) thick.

Perform initial rolling using oscillating-axle pneumatic-tired rollers with a minimum 20 ton (18 mt) operating weight and not less than 250 pounds (113.5 kg) per inch (25 mm) width of tire tread. Perform finish rolling meeting the requirements of Subsection 401.03.12(A). Compact the material to the density specified by the Project Manager.

- C. Compaction Control Testing.** Perform all necessary density testing to control compaction.
- D. Acceptance Testing.** The pavement density is determined at randomly selected locations after all rolling is complete and before the roadway is open to traffic. The density is determined using MT-212 and MT-313. The core correlation is added to all nuclear density test results.

The density is divided by the Field Marshall Target density currently in effect to arrive at a percentage. The Field Marshall Target density for the mix is established by the Project Manager from the test results using MT-311.

The Project Manager will select the test locations using random selection based on the tons (metric tons) of mix placed. Areas within 1 foot (305 mm) of a free edge or where the nominal thickness is less than 0.10 foot (30 mm) are excluded from testing.

The approximate mix quantity represented by each test is 600 tons (600 mt). Additional tests may be made at the Project Manager's discretion. The quantity represented by five tests or approximately 3,000 tons (3000 mt) of mix constitutes a lot whenever production schedules and material continuity permit. The Project Manager will establish a lot represented by three to seven consecutive random samples when there are short production runs, significant material changes, or other unusual characteristics of the work.

- E. Acceptance.** Plant mix surfacing is evaluated for density on a lot-by-lot basis under Subsection 105.03.2, except as noted in Subsection 401.03.12(B).

401.03.13 Pavement Repair

Cut out the defective pavement to a minimum 1-inch (25 mm) depth. Clean the sides and bottom of the hole and apply approved bitumen to the surfaces. Fill the hole with fresh mix, level, and compact to the specified density and surface smoothness.

401.03.14 Surface Tolerances

Finish the surface of each final lift to the specified grade and cross section. Table 401-2 values specify the maximum allowable variance and divergence from the mean constructed grade:

TABLE 401-2
MAXIMUM ALLOWABLE VARIANCE AND DIVERGENCE

SURFACE	TOTAL VARIATION	RATE
New Plant Mix Bituminous Surfacing	0.02 foot (6 mm)	0.20%
Plant Mix Overlays (2 or more planned lifts)	0.03 foot (9 mm)	0.30%
Plant Mix Overlays (less than 2 planned lifts)	0.03 foot (9 mm)	No rate

The rate is applicable only to the longitudinal direction.

New plant mix bituminous surfacing includes the plant mix seal.

The mean constructed grade for each section is the planned grade or a grade parallel to plan grade, acceptable to the Engineer.

Surfaces will be checked for compliance at joints, bridge ends, and other sections where ride characteristics or other evidence indicates surface tolerance is outside the specifications.

Surface smoothness is measured longitudinally in 100-foot (30.5 m) sections at 10-foot (3 m) intervals, and transversely at 4-foot (1.2 m) intervals. Correct out of specification plant mix bituminous surfacing by any method approved by the Engineer, including cold milling at least 0.12 foot (38 mm) deep, the full width of the defect but not less than the paver width and for 50 feet (15.2 m) each side of the defective pavement. Fill the milled area with like material and compact to the specified density.

The corrected pavement and adjoining surface must meet the smoothness specifications.

The Contractor will be notified of sections to be corrected within three working days after the surface was placed or the final day of paving. Perform all corrective work at Contractor expense.

Transverse joints in lifts of plant mix surfacing or other lifts to be used by traffic for 15 days or more must not vary more than 3/8-inch (10 mm) from any point on a taut 25-foot (7.6 m) string line placed parallel to centerline. Plant mix seal courses must not vary by more than 3/16-inch (5 mm).

New surfaces will be checked for a minimum of 100 feet (30.5 m) by placing the string line in half-length increments along the roadway in traffic lanes.

Corrected areas including new joints will be checked for meeting the surface tolerances.

401.03.15 Rumble Strips

Cut the rumble strips into the finished plant mix pavement. Use a machine equipped with a rotary type cutting head capable of making the cuts to the dimensions and pattern shown in the Detailed Drawings.

Establish a control line and locate the rumble strips on the shoulder 6-inches from the outside edge of the travel lane. The offset may be adjusted to avoid longitudinal pavement joints. Do not place rumble strips where concrete median barrier rail or other roadside features prevent placement as specified.

Apply a fog seal to the finished rumble strips. Use SS-1 or CSS-1 emulsion for the fog seal. Dilute the emulsion with water at a 1:1 ratio and apply at 0.05 to 0.15 gallons per square yard (0.20 to 0.60 liters per square meter).

Keep traffic off the fog seal until the emulsion has cured to no-track.

Apply the fog seal to the rumble strip for each lane in the direction of travel for that lane.

Produce the rumble strips without tearing and snagging the pavement.

Remove and dispose of the waste material meeting all applicable local, state, and federal regulations.

401.04 METHOD OF MEASUREMENT

401.04.1 Plant Mix Pavement

Plant mix pavement is measured by the ton (metric ton) on approved scales after complete mixing of all ingredients. The pay weight includes the bituminous material and any mineral filler or hydrated lime in the mixture.

401.04.2 Bituminous Material

Bituminous material is measured by the U.S. gallon (Liter) or the ton (metric ton), as specified, under Subsection 402.04, excluding anti-stripping additive.

401.04.3 Mineral Filler

Mineral filler is measured by the ton (metric ton) under Subsection 109.01.

401.04.4 Hydrated Lime

Hydrated lime is measured by the ton (metric ton) under Subsection 109.01.

401.04.5 Anti-stripping Additive

Anti-stripping additive is measured for payment based on invoice prices.

401.04.6 Rumble Strips

Rumble strips are measured by the mile (kilometer) to the nearest tenth of a mile (tenth of a kilometer) along the centerline of the roadway, less all gaps in the rumble strips due to ramp terminals, objects, etc. Each individual line of rumble strips is measured separately.

Fog seal for rumble strips is measured by the undiluted gallon of SS-1. The quantity shown in the contract is an estimate of undiluted SS-1 needed to complete the work and is calculated using an application rate of 0.05 gallons per square yard (0.20 liters per square meter) and an applied width of 24 inches (600 millimeters).

401.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

<u>Pay Item</u>	<u>Pay Unit</u>
Plant Mix Pavement	Ton (metric ton)
Bituminous Material	Gallon (liter) or Ton (metric ton)
Mineral Filler	Ton (metric ton)
Hydrated Lime	Ton (metric ton)
Anti-stripping Additive	Ton (metric ton)
Rumble Strip	Mile (kilometer)
Emulsified Asphalt SS-1	Gallon (liter)

Payment will not be made for any claim for rejecting any batch or load of mix containing bituminous material varying more than 0.3 percent from the established percentage in the job mix formula. The contract unit price for rumble strips will be adjusted as shown in Table 401-3:

**TABLE 401-3
PRICE ADJUSTMENTS DUE TO LINE DEVIATIONS**

LINE DEVIATION FROM THE TRUE LINE	PRICE ADJUSTMENT
0.0 feet to 0.15 feet (0 to 50 mm) in 500 feet (152 m)	None
0.15 feet to 0.25 feet (50 mm to 75 mm) in 500 feet (152 m)	50% price reduction
Greater than 0.25 feet (75mm) in 500 feet (152 m)	Correct as directed

Mineral filler and hydrated lime used in the work but not specified in the contract is paid for at an agreed price under Subsection 109.04.

Furnish certified copies of invoices to support the prices for mineral filler, hydrated lime, and anti-stripping additives.

Payment at the contract unit price is full compensation for all necessary resources to complete the item of work under the contract.

SECTION 402

BITUMINOUS MATERIALS

402.01 DESCRIPTION

This work is the furnishing and applying bituminous materials, on bases and surfacing.

402.02 MATERIALS

Furnish bituminous materials meeting Section 702 and the contract requirements.

402.03 CONSTRUCTION REQUIREMENTS

Mix and apply bituminous material meeting the applicable requirements in Sections 401, 406, 407, 409, and 410.

402.03.1 Materials Source

Obtain the Engineer's approval of the bituminous source before delivering the material to the project. Do not change the source of supply once work is started, without the Engineer's written approval.

402.03.2 Sampling

- A. General.** Take bitumen samples, other than products accepted under quality assurance, at the point of delivery on the project.

The Contractor or designated representative is responsible for sampling the bituminous materials on the project using MT-302.

Drain off and discard at least 1 gallon (3.8 L) of the bituminous material before drawing samples.

Draw two one-quart (0.9 L) samples from each shipment, witnessed by the Project Manager. Forward one sample for testing and retain the second sample for use as specified in Subsection 702.02.

Equip all transport vehicles with a spigot or gate valve in the unloading line, or in the tanker at the centerline of the tank, or in the pressure line from the unloading pump, or at another approved location. The spigot or gate valve diameter must be between 3/8-inch (9.5 mm) and 3/4-inch (19 mm). Locate the spigot or valve to prevent plant dust or other sample contamination.

- B. Asphalt Sampling (Quality Assurance Sampling).** Sample asphalt cement for plant mix surfacing and base and plant mix seal course using a sampling device located in the line between the storage facilities and the mixing plant.

Provide a sample of the asphalt cement entering the mixing plant. One approved in-line sampling device is shown in ASTM D 140.

Place the samples in Department furnished containers. Give the samples to the Project Manager immediately after sampling.

The Project Manager will randomly designate the time of sampling based on the tons (metric tons) of completed mix produced. The approximate quantity of mix represented by each sample is 500 tons (500 mt). The Project Manager may require additional samples and testing.

Six samples represent approximately 3000 tons (3000 mt) of mix and constitute a lot whenever production schedules or material continuity permit. The Project Manager may establish a lot consisting of the quantity represented by any number of consecutive random samples, from three to seven inclusive, when necessary to represent short production runs, significant material changes, or other unusual characteristics of the work.

402.03.3 Shipping

Ship the bituminous material in clean, uncontaminated, fully insulated cars or trucks, sealed by the supplier after loading.

402.03.4 Testing

Bituminous materials are accepted on the test results of samples selected and tested under Subsection 702.02 by the Department or its authorized representative.

402.03.5 Acceptance

A. General. Provide the Project Manager a copy of the original bill of lading and a copy of the certificate of compliance, with each shipment. Assure the certificate is signed by the supplier's representative and attests that the bituminous material meets the Department's specifications for the type and grade of material provided and that the shipping container was inspected and found free of contamination. The certificate of compliance is the basis for tentative material acceptance and use.

B. Asphalt Cement Penetration (Quality Assurance). Asphalt cement for bituminous plant mix surfacing and base, and plant mix seal course is tested for penetration on a lot-by-lot basis. Acceptance is by Subsection 105.03.2. Asphalt cement with an anti-stripping additive is not evaluated under this provision.

The asphalt cement quantity in a lot, used for calculating the amount of price reduction, is based on the job mix target value of asphalt for that lot and the total tons (metric tons) of completed mix in the lot.

C. Failures Other than Asphalt Cement Penetration (Non-quality Assurance). If a shipment of bituminous material fails to meet any of the specifications, other than penetration, after the tolerances in Subsection 702.02 are applied, the material may be accepted at a 10% price reduction of the bituminous material cost.

If a shipment fails to meet any one of the specifications after twice the allowable tolerances have been applied, the price reduction will be 25 percent of the bituminous material cost.

If a shipment fails to meet any one of the specifications after triple the allowable tolerances have been applied, the Engineer may reject the material and require its removal from the work, or the Engineer may accept the material at a 50 percent price reduction of the cost of the bituminous material.

The cost of the bituminous material for calculating price reductions is the material's contract unit price.

If a shipment fails more than one of the specifications, the failure causing the largest percentage price reduction is assessed.

402.03.6 Loading and Application Temperatures

The Project Manager will designate the recommended application temperature ranges using Table 402-1.

Do not heat bituminous mix any higher than is necessary for proper hauling and placing.

Do not introduce aggregate into a mixer higher than 25 °F (14 °C) above the bituminous material temperature.

Furnish the Project Manager with data on the temperature-viscosity relationship of each asphalt to be used on the project. The data must cover the recommended temperature range and viscosities at which the asphalt may be used. The Project Manager will use this data to specify the temperature at which the material will be used.

TABLE 402-1
RECOMMENDED APPLICATION TEMPERATURES
FOR BITUMINOUS MATERIALS

LIQUID ASPHALTS - RC, MC and SC				
Grade	Loading Temp. Max.¹ °F (°C)	Spraying Temperature	Mixing Temp. of Aggregates for MC & SC Liquid Asphalts	
			Min. °F (°C)	Max. °F (°C)
70	195 (91)	As required to achieve viscosity of 50-200 centistokes (25-100 Sec. Saybolt Furol) ²	90 (32)	155 (68)
250	245 (118)		125 (52)	200 (93)
800	275 (135)		160 (71)	225 (107)
3000	310 (154)		200 (93)	260 (127)

EMULSIFIED ASPHALTS				
Grade	Mixing Temperature		Spraying Temperature	
	Min. °F (°C)	Max. °F (°C)	Min. °F (°C)	Max. °F (°C)
Slow and Medium Setting	50 (10)	130 (54)	50 (10)	130 (54)
Rapid Setting	125 (52)	185 (85)	120 (49)	160 (71)

ASPHALT CEMENTS		
Grade	Mixing Temperature	Spraying Temperature
		Max. °F (°C)
All Penetration Grades	Established by Project Manager	350 (177)

Notes:

1. Line Temperatures
2. See Temperature - Viscosity Charts (MT-308)

402.03.7 Alternate Type or Grade of Bituminous Materials

The Engineer may change or substitute, in writing, the type and grade of bituminous material specified.

Payment for the changed or substituted bituminous material is the contract unit price for the type and grade of bituminous material plus or minus the difference in Contractor's cost at the refinery between the specified and substitute type and grade.

402.03.8 Performance Graded Asphalt Binder (PGAB)

Furnish Performance Graded Asphalt Binder (PGAB) meeting Table 702-9 requirements for the binder specified in the contract. PG 64-28, PG 64-34 and PG 70-28 binders, after aging in the rolling thin film oven, and testing under AASHTO T-51 must meet the following:

- Pull Rate: 2 inches per minute (5 cm per minute);
- Sample Temperature: 77 °F (25 °C); and
- Ductility: 1 foot (30 cm) minimum.

Notify the Project Manager in writing before making changes to the PGAB components.

- A. Test Results.** Provide current test results for all PGAB requirements for material furnished.

Furnish the PGAB test data with the first delivery and for each 2,000 tons (2000 mt) delivered to the project.

- B. PGAB Shipping, Handling, and Storage.** Ship, handle, and store the PGAB following the supplier's requirements. Furnish a copy of the requirements before delivering the PGAB to the project. Ensure that the supplier's requirements are consistent with the material manufacturers. PGAB exhibiting separation, crusting, or foaming during delivery or in storage tanks will be rejected.

- C. Sampling.** Sample the PGAB meeting subsection 402.03.2(B). A sample is two one-pint (two 500 ml) containers of PGAB.

- D. Acceptance.** The Department will grade samples representing each lot using the PGAB grading system, and Table 702-9, with duplicate containers retained for testing in case of dispute. PGAB is accepted under Subsection 105.03.2 using an 'F' factor of 4. The "P" value is determined for the high temperature components of the resulting grade (i.e. 64, 58, etc.) using the formula:

$$P = (TL + aR - Xn) \times F$$

The "P" value is determined for the low temperature component of the resulting grade (i.e. -34, -28, etc.) using the formula:

$$P = (Xn + aR - Tu) \times F$$

Positive 'P' value is added to determine the lot's total price reduction. No disincentive will be assessed for 'P' values less than 13, based upon MDT's initial grading. This disincentive exclusion in 'P' value will not be applied to averaged results described below.

If the calculation results in a price reduction ('P' value of 13 or greater), the Contractor may make a written request for an independent laboratory to grade the duplicates for the lot in question. Ensure the Department receives the written request within 30 calendar days of the notification of price reduction. The Contractor and the Department will agree upon the choice of independent laboratory before release of the duplicate samples for testing. The independent laboratory results will be averaged with the results provided by the Department. The averaged results are binding on both parties for acceptance and payment of the material in question. The 'P' value will be calculated based upon the averaged results, with no exclusion allowed for results less than 13. Pay the cost of the duplicate testing, on a per lot basis, if the price reduction is confirmed or increased. The Department will pay the cost of the duplicate testing, on a per lot basis, if the price reduction is reduced.

The ductility requirement has no tolerance. Immediately stop paving if the binder fails the ductility requirement. Do not start paving until binder meeting the specifications is furnished.

402.04 METHOD OF MEASUREMENT

Bituminous material is measured by the gallon (liter) or the ton (metric ton), as specified in the contract.

If measured by the gallon (liter), the volume of bituminous material is determined at a temperature of 60 °F (15.6 °C) or corrected to this using the appropriate group table designated in the ASTM D 1250 volume correction tables. Transport bituminous materials measured by the gallon (liter) in tanks certified as to capacity. Provide a measuring rod and calibration card with

each tank. Railroad tank cars must have available inage and outage tables and dome capacity charts.

When measured by the ton (metric ton), the bituminous material weight is measured on scales furnished by the supplier or on public scales close to the source. Weigh each transporting vehicle for bituminous materials, other than railroad tank cars, empty and loaded. The weight difference is used for computing the tonnage (metric tonnage). Furnish an approved scale that can weigh the transporting unit in an unbroken operation. Test and seal the scales at Contractor expense when directed.

For plant mix operations, the bituminous material may be weighed by the plant scales, if approved.

If railroad tank cars transport the bituminous materials, the railroad car weights may be used for computing the weight of bituminous material, if the loaded cars are weighed over track scales. The stenciled tare on the car used for determining the net weight is subject to verification.

Use flow rate meters under Subsection 401.03.2(D)(7), to measure the material. Document meter readings by invoices. The Project Manager may take tank stabs for verification purposes.

402.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

<u>Pay Item</u>	<u>Pay Unit</u>
Bituminous Material	Gallon (liter) or Ton (metric ton)

Payment includes all costs to furnish, deliver, heat, haul, and apply the bituminous material.

For plant mix operations, the maximum volume of bituminous material eligible for payment on a shift basis is the target bituminous content plus 0.3 percent.

Payment at the contract unit price is full compensation for all necessary resources to complete the item of work under the contract

SECTION 403 CRACK SEALING

403.01 DESCRIPTION

This work consists of routing, cleaning and sealing the transverse and specified longitudinal cracks meeting the dimensions specified under 403.03.1 in the roadway surface with the specified sealant.

403.02 MATERIALS

A. Crack Sealant. Use sealant meeting the ASTM D 5167 specifications in Table 403-1:

**TABLE 403-1
CRACK SEALANT SPECIFICATIONS**

PROPERTY	REQUIREMENT
Cone Penetration, 77 °F (25 °C), dmm (ASTM D5329)	100-150
Cone Penetration, 0 °F (-18 °C), dmm (ASTM D5329 modified)	25 min.
Flow, 140 °F (60 °C), 5h (ASTM D5329)	0.4 inch (10mm) max.
Resilience, 77 °F (25 °C), (ASTM D5329)	30% to 60%
Bond, -20 °F (-29 °C), 200% ext. (ASTM D5329)	Pass 3 cycles
Recommended Pour Temperature	380 °F (193 °C)
Safe Heating Temperature	410 °F (210 °C)
Asphalt Compatibility (ASTM D5329)	Pass

Submit a 30 lb (13.6 kg) sample for the first lot of the sealer proposed for project use to the Helena Materials Bureau for testing at least 20 calendar days before its intended application. Submit the sample in its original packaging with the batch number legible.

Do not use the first lot of sealant before it is approved.

The Department will take one random sample from each additional lot for testing.

B. Backer Rod. Furnish backer rod meeting ASTM D-5249, Type 1, sized for cracks meeting 403.03.3.

C. Blotter Material. Use toilet paper for blotter material.

403.03 CONSTRUCTION REQUIREMENTS

403.03.1 General

Work one-half of the roadway at a time.

Limit routing and crack sealing work to one maximum 2.0-mile (three-kilometer) work area.

403.03.2 Routing

Rout all existing cracks that are between 1/8 inch (3 mm) and 1 inch (25 mm) wide.

Rout all longitudinal cracks to produce straight 3/4-inch (19 mm) vertical walls and a 3/4 inch (19 mm) wide flat bottom reservoir.

Rout the transverse cracks to produce straight 1/2-inch (13 mm) vertical walls and a 1 1/2 inch (40 mm) wide flat bottom reservoir.

Rout when the roadway is dry.

Remove and dispose of the routed material from the roadway before opening the roadway to traffic.

403.03.3 Cleaning

The reservoir and crack must be dry and free of dust, dirt and loose materials immediately before placing the backer rod, if applicable, and applying the sealant.

403.03.4 Sealing

Install backer rod in cracks 1 1/2-inch (40 mm) wide and larger.

Place sealant material within 72 hours of routing.

Follow the sealant manufacturer's handling, mixing and application temperature requirements:

- Apply sealant filling the reservoir flush to the top using a pressure type applicator;
- Open the completed work to traffic once the sealant does not track; and
- Repair or replace all seal work damaged by traffic at Contractor expense.

All cracks sealed require blotter material.

403.03.5 Temperature Limitations

Do not rout when the mat temperature is below 35 °F (1.67 °C).

Apply the sealant when the roadway surface temperature is between 35 °F (1.67 °C) and 120 °F (49 °C).

403.04 METHOD OF MEASUREMENT

Crack sealing is measured by the pound (kg) of material placed.

Blotter material is not measured separately.

403.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item

Crack Sealing

Pay Unit

Pound (kilogram)

Blotter material is included in the contract unit price and is not paid for separately.

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work under the contract.

SECTION 406

ROAD MIX BITUMINOUS PAVEMENT

406.01 DESCRIPTION

This work is the construction of one or more courses of a mixture of aggregate and bituminous material, mixed and processed on the roadway.

406.02 MATERIALS

406.02.1 Bituminous Material

Furnish the type and grade of bituminous material specified in the contract meeting the requirements of Sections 402 and 702.

406.02.2 Aggregate

Furnish the aggregate specified in the contract meeting the applicable Section 701 requirements.

406.03 CONSTRUCTION REQUIREMENTS

406.03.1 Prosecution of Work

Furnish the resources to complete at least 1/2 mile (0.80 km) of continuous road mix bituminous pavement each day on projects 5 miles (8 km) or more in length.

On projects less than 5 miles (8 km) in length, complete the work within 10 working days.

Do not open up more than 2 miles (3.2 km) of work to any one phase of construction. Do not perform bituminous construction on more than 3 contiguous miles (4.8 km) of roadway.

406.03.2 Equipment

A. Bituminous Distributor. Maintain on the project at least one bituminous distributor meeting Subsection 410.03.1(A) requirements.

B. Motor Graders. Use motor graders meeting Subsection 210.03.2 requirements.

C. Road Plants and Machines. Use equipment capable of producing the specified work.

Do not damage the existing surface. Remove any equipment that damages the roadway or does not produce the specified work.

D. Stationary Plants. A stationary plant may be used for mixing the new aggregate and bituminous material, if approved. Mixing and aeration of the material, if not completed in the plant, must be completed on the roadway meeting these specifications.

The Project Manager may permit mixing, spreading, and compacting the materials under Section 401.

E. Rollers. Furnish rollers meeting Subsection 210.03.4 requirements.

406.03.3 Limitations and Conditions

A. Weather, Season, and Time. Perform road mix bituminous paving when the roadway surface is dry, the temperature is above 50 °F (10 °C) and during daylight hours.

B. Stockpiling. Windrow stockpile the aggregate on the roadway only for mixing operations that can be completed without interruption.

The Contractor may produce and stockpile the aggregate off the roadway at its own expense. Stockpile aggregate meeting Subsection 303.03 requirements.

C. Moisture Content. Do not allow the aggregate moisture content to exceed three percent by weight before applying the bituminous material.

When emulsified asphalt is specified, the maximum moisture content of the aggregate is specified in the contract or directed by the Engineer.

Cease work during periods of rain and immediately windrow the material. Maintain drainage away from the windrows.

Dry the treated material and the base before resuming work. Mixing is permitted to aid drying. Place the bituminized mixture on the roadbed, once approved by the Project Manager. Do not place the mixture if the moisture content in the upper 6-inches (150 mm) of the base exceeds 3 1/2 percent.

406.03.4 Traffic Control and Protection of Highway Structures

Place traffic control meeting the contract requirements and the approved traffic control plan. Protect highway structures meeting the requirements of Subsection 410.03.9.

Park all equipment at least 30 feet (9.2 m) from the edge of the traveled way or place it a minimum 10 feet (3 m) behind guardrail when work is suspended and traffic has use of the roadway.

Leave all material in a uniform windrow without interfering with traffic, signed and delineated as specified or directed. Leave the roadway in a safe condition for the traveling public.

406.03.5 Prime or Tack Coat

Apply the prime or tack coat under Section 407.

406.03.6 Aggregate

Where aggregate is recycled from the existing roadway, scarify the surface to produce the material quantity required for the compacted thickness of bituminous surfacing shown in the plans. Do not disturb the base surface below the depth required to produce the necessary quantity of material. Break all clods and windrow the loose material. Shape and compact the base surface to the typical section.

Uniformly mix recycled and new material before applying the bituminous material.

When only new aggregate is to be used, shape and compact the existing roadway surface to the specified sections. Apply prime coat as specified before placing the new aggregate. Uniformly windrow the new aggregate on one side of the roadway. Make the windrow uniform in size throughout its entire length.

406.03.7 Application of Bituminous Material

Apply bituminous material at the rates, temperature, and manner specified. Assure all aggregate is uniformly coated with bituminous material.

When applying bituminous material with distributors or mixing machines equipped with applicators, spread the windrowed aggregate in successive layers at least 8 feet (2.4 m) wide. Uniformly apply the bituminous material to the full width of each layer. Make at least three layers of aggregate and bituminous material.

406.03.8 Processing

Blade all surfacing material into a windrow after the last application of bituminous material and partial mixing. Move the windrow from side to side of the roadway a minimum of eight times working the aggregate until it is uniformly coated with bituminous material and is aerated for spreading and compacting.

A move is moving the entire mass from one edge of the roadway section to the other. If necessary, make additional moves to produce the desired mix uniformity. Prevent segregation of material or loss of mineral filler from the mixture.

Once mixing is completed, the Project Manager will inspect the mixture for acceptance. If excessive bituminous material was applied, add additional aggregate to the mixture and

thoroughly blend by blade mixing. If more bituminous material is required, spread the mixed material needing more bitumen on one side of the roadway, add the required additional bituminous material and resume mixing until the mix is uniform.

Remove oversize material in the mixture during mixing.

406.03.9 Spreading and Compacting

Spread the mixed material to the specified thickness using a pneumatic-tired motor grader.

Compact the material with a self-propelled pneumatic-tired roller that provides at least 60-psi (414 kPa) pressure on the mat.

Continue rolling until the mat is uniformly and thoroughly compacted leaving no roller marks. Begin rolling on the low side of the paving lane and roll lengthwise and parallel to the high side, each pass overlapping the preceding pass by at least 6 inches (150 mm).

Final roll using a metal-wheeled roller operated at speeds between 3 miles per hour and 8 miles per hour (5 km/h and 13 km/h). Correct roller speed if the roller displaces the material.

Do not use kerosene or diesel fuel to prevent pickup on the finishing roller. Correct all defects before opening the road to traffic.

The finished surface must be free of ruts, depressions or other surface defects exceeding 3/8-inch (10 mm), as measured with a 10-foot (3 m) straightedge paralleling the roadway center. Make corrections by scarifying and relaying the mixture at Contractor expense.

406.03.10 Seal Coat

Apply seal coat when specified under Section 409.

406.04 METHOD OF MEASUREMENT

406.04.1 Bituminous Material

Bituminous material is measured by the gallon (liter) or ton (metric ton) under Subsection 402.04.

406.04.2 Aggregate

New or additional aggregate for the bituminous surfacing course and the shoulders is measured by the cubic yard (cubic meter) or ton (metric ton) under Subsection 301.04.1.

406.04.3 Processing

Processing of all bituminous surfacing materials is measured by the mile (km) along the centerline of the roadway or by the square yard (square meter).

406.04.4 Rolling

Rolling is incidental to and included in payment for other items of the work.

406.04.5 Reserved

406.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item

Bituminous Material
Aggregate
Processing

Pay Unit

Gallon (liter) or Ton (metric ton)
Cubic Yard (cubic meter) or Ton (metric ton)
Mile (kilometer) or
Square Yard (square meter)

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work under the contract.

When emulsified asphalt is specified, the cost of additional water required during mixing is included in the contract unit price for emulsified asphalt.

The grade of bituminous material may be changed one step by the Engineer with no adjustment in price.

When stationary plants are used for mixing, the weight of bituminous materials and mixing water are deducted from the total mix weight.

SECTION 407

BITUMINOUS PRIME AND TACK COAT

407.01 DESCRIPTION

This work is the furnishing and applying a bituminous material, and a blotter material if required, to an existing surface.

Prime coat is applying a bituminous material to a prepared aggregate or soil-surface roadway before placing bituminous surfacing.

Tack coat is applying a bituminous material to a constructed bituminous or concrete surface before placing a bituminous surfacing.

407.02 MATERIALS

407.02.1 Bituminous Material

Furnish bituminous material meeting Section 702 requirements for the type and grade specified.

The Project Manager may change or substitute the type and grade of bituminous material to be used under Subsection 402.03.7.

A one step change in grade will not change the contract unit price.

The Contractor may substitute CSS-1 emulsified asphalt for SS-1 emulsified asphalt for tack coat.

407.02.2 Blotter Material

Blotter material is material with 100 percent passing the 1/2-inch (12.5 mm) screen and having a PI of 6 or less.

407.03 CONSTRUCTION REQUIREMENTS

407.03.1 Weather Limitations

Apply prime and tack coat to a dry surface during daylight hours.

Apply prime when the ambient temperature is 50 °F (10 °C) or higher.

Apply the tack coat when the ambient temperature is 50 °F (10 °C) or higher, or when the surface temperature is 35 °F (2 °C) and rising.

Do not place plant mix on any surface with a tack coat until the tack coat has cured (breaks) as determined by the Project Manager.

Apply the prime and tack coat after the Project Manager has approved the surface to receive the bituminous material.

Apply tack coat subject to the surface conditions and weather limitations in Subsection 401.03.6.

407.03.2 Equipment

Use equipment meeting Subsection 410.03.1 requirements.

407.03.3 Application of Bituminous Materials

Apply bituminous material as specified in Subsection 410.03.4, except as modified or supplemented by this Subsection.

The 3 percent moisture requirement in Subsection 410.03.2 is not applicable.

The Project Manager will establish the bituminous material application rate.

Apply water as directed to the aggregate base surface before the surface is primed.

Treat only one-half of the roadway width in one application.

Do not exceed the specified quantity of bituminous material at spread junctions. Correct excess or deficient coated areas to the specified application rate.

Apply emulsified asphalt for tack coat as specified by the Project Manager up to a maximum rate of 0.1 gallon per square yard (0.45 L per square meter). Maintain from 1 to 3 parts of water to 1 part of emulsified asphalt. The Project Manager will determine the exact proportions.

407.03.4 Application of Blotter Material

Spread, and compact if required, blotter material over primed surfaces as directed.

Sweep or blow excess blotter material onto the shoulders and in-slopes before placing subsequent bituminous surfacing courses. Remove and dispose of all excess material on adjoining curbs and gutters.

407.03.5 Maintenance of Surface

Maintain the prime or tack coated surface until covering with subsequent surfacing.

Repair all defects, deterioration or disintegration of the underlying surfacing course or courses as directed.

407.03.6 Traffic Control and Protection of Highway Structures

Furnish traffic control meeting the approved traffic control plan and Section 618.

Furnish highway structure protection as specified in Subsection 410.03.9.

407.04 METHOD OF MEASUREMENT

407.04.1 Bituminous Material

Bituminous material is measured by the gallon (Liter) or the ton (metric ton), as specified, under Subsection 402.04.

407.04.2 Blotter Material

Blotter material is measured by the ton (metric ton) or cubic yard (cubic meter).

407.04.3 Surface Repair

The surface repairs in Subsection 407.03.5 are not measured for payment except as follows:

The Project Manager may direct priming the surface before a winter shutdown. All traffic related damage areas during the shutdown period that are repaired are measured for payment at the appropriate contract unit prices, including additional materials.

407.04.4 Miscellaneous

Water for diluting emulsified asphalt used in the work is not measured for payment.

407.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

<u>Pay Item</u>	<u>Pay Unit</u>
Bituminous Material	Gallon (liter) or Ton (metric ton)
Blotter Material	Ton (metric ton) or Cubic Yard (cubic meter)

Payment at the contract unit price is full compensation for all necessary resources to complete the item of work under the contract.

The blotter and bituminous material quantities in the contract are estimated and may be increased or decreased with no adjustment of the contract unit prices.

SECTION 409

SEAL COAT

409.01 DESCRIPTION

Seal coat is the application of a bituminous material, covered with aggregate on an existing roadway surface.

409.01.1 Contract Time

In cases where seal coat and pavement marking application are the only remaining items of work, contract time will be charged according to Subsection 108.07.3 beginning the first working day following the July 4 (Independence Day) holiday.

Submit written notice to perform seal coat work prior to the July 4 (Independence Day) holiday or holiday weekend.

Time charges according to Subsection 108.07.3 for seal coat work performed prior to the July 4 (Independence Day) holiday will commence on the date indicated in the Contractors written notice.

409.02 MATERIALS

409.02.1 General

Furnish aggregate and bituminous materials that are compatible. Submit compatibility test results for each aggregate source for informational purposes. One recommended compatibility test method is MT-322.

409.02.2 Bituminous Material

Furnish material meeting Table 702-8.

409.02.3 Cover Aggregate

Furnish cover aggregate meeting Subsection 701.02.8 and Table 701-12 requirements.

If the contract specifies "Cover - Type I," furnish Grade 4A cover material. If the contract specifies "Cover - Type II", furnish Grade 2A cover material.

The responsibility for furnishing the aggregate source is specified in the contract.

409.03 CONSTRUCTION REQUIREMENTS

409.03.1 Sampling, Testing, and Acceptance

The Project Manager will randomly select samples taken by the Contractor and witnessed by an Inspector, for gradation and fracture testing. Sample from the belt on the chip spreader, using AASHTO T 2 procedures, or at another location approved by the Project Manager.

The following acceptance tests are used:

- Gradation MT-202
- Mechanical Fracture MT-217

The quantity of material placed in 192,500 square yards (178,500 square meters) is considered equivalent to a 2500-ton (2500 metric ton) lot, and the quantity of material placed in 38,500 square yards (35,700 square meters) is considered equivalent to a 500-ton (500 metric ton) subplot for the purposes of aggregate analysis and acceptance.

The quantity represented by five samples is a lot when production schedules and material continuity permit. The Project Manager may establish a lot consisting of a quantity represented by three to seven consecutive random samples when there are short production runs, significant material changes, or other unusual characteristics of the work.

Surfacing aggregates are evaluated for gradation and mechanical fracture, on a lot-by-lot basis. The upper and lower limits in the gradation table, Table 701-12 are the upper and lower limits in the evaluation formulas. The specified minimum fracture values are the lower limit. Acceptance is made under Subsection 105.03.2.

409.03.2 Aggregate and Bituminous Material Application Rates

Determine the application rates for aggregate and bituminous material used to complete a test section and the project. Submit the following for informational purposes:

1. Aggregate and bituminous material application rates;
2. Bituminous materials supplier's recommended ambient and pavement surface temperatures;
3. Bituminous material supplier's recommended application temperature range; and
4. Elapsed time between the application of the bituminous material and the cover aggregate.

Before starting full production, complete a test section at least 2000 feet (0.6 km) long to verify the following:

1. Optimum bituminous material and aggregate application rates;
2. Time frame to complete each phase of the seal coat operation to meet the requirements for opening the roadway to traffic; and
3. Roller type, number of passes and pattern of rolling operations.

Do not begin production seal coat work until the test section has been placed and approved by the Project Manager.

409.03.3 Seasonal and Weather Limitations

The following conditions govern seal coat work:

1. Perform seal coat operations between May 1 and August 31.
2. Do not perform seal coat work during the 48-hour period immediately preceding a holiday or a holiday weekend except for pilot car operation as specified in Subsection 618.03.11.
3. Perform seal coat work when both the ambient and pavement surface temperatures meet the bituminous material supplier's recommended temperatures.
4. Stop seal coat work at least 1/2 hour before sunset, to include equipment off of the roadway and placement of traffic control devices for non-construction activities.

The following are weather related recommendations for seal coat work:

1. Do not perform seal coat work if the weather forecast for the project site includes a predicted temperature lower than 45 °F (7 °C) within 12 hours after the intended close of work for the day.
2. Do not perform seal coat work if the weather forecast for the project site includes a probability of precipitation greater than 45 percent within the intended schedule of operations for the day.
3. Stop seal coat work if the wind velocity affects the distributor spray pattern or current weather conditions prevent producing the specified results.
4. Do not apply bituminous material to damp or wet roadway surfaces.

409.03.4 Protection of Traffic and Highway Structures

Provide traffic control meeting Section 618 and the approved traffic control plan. Provide highway structure protection meeting Subsection 410.03.9(B). Provide dust control during sweeping and brooming.

409.03.5 Surface Preparation

Do not apply bituminous material unless the roadway surface is free of all dust, dirt, and foreign material.

409.03.6 Application of Fog Seal

The Contractor may, at their option, apply a fog seal using SS-1 or CSS-1 emulsions meeting subsection 402.03.6 requirements, on Grade S plant mix surfaces prior to application of seal coat materials. Notify the Project Manager in writing two days prior to application of fog seal. Specify the emulsion type and the application rate in the notification. For each completed section, as described in Subsection 618.03.11, the Department will pay for all pilot cars, flaggers, signs and necessary traffic control devices used for up to 12 hours. Traffic Control beyond 12 hours, unless ordered by the Project Manager, is at Contractor expense.

409.03.7 Application of Seal Coat Materials

Apply bituminous material at the rate established by the test section. Apply the bituminous material within the bituminous material supplier's recommended temperature range.

Ensure that transverse and longitudinal joints are smooth and match the adjacent surfaces. Keep meet lines to a minimum. Locate longitudinal joints outside the wheel paths.

For requests to apply full roadway width bituminous and aggregate applications in a single, continuous operation, provide the Project Manager two copies of a sequencing plan that ensures the least traffic impact for approval, at least five working days before the planned operation.

Uniformly apply the cover aggregate on the bituminous material at the rate established by the test section. When constructing longitudinal joints, one recommended method is to cover the joint with aggregate and sweep the aggregate back before applying adjacent bituminous material. When longitudinal joints are covered to permit vehicle cross over, sweep back the cover aggregate to expose the joint before applying adjacent bituminous material.

409.03.8 Warranty

If the seal coat experiences chip loss, tracking, flushing or bleeding, at any time, within 60 calendar days of seal coat completion, perform repairs to the seal coat at no additional cost to the Department. When repairs are deemed necessary, reference is made to the "MDT Seal Coat Warranty Administration Guide." Submit a detailed repair plan for approval. Make warranty repairs in accordance with the provisions of this specification. When performing warranty work, furnish traffic control meeting Section 618 requirements at no additional cost to the Department.

409.03.9 Application of Blotter Material

Monitor the finished seal coat and apply blotter material on live oil areas throughout the specified warranty period. Live oil is defined as bituminous materials that have not fully set or bonded to cover material particles. Live oil has a glossy appearance and is present in tracking, flushing and bleeding conditions. Failure to apply blotter material within 24 hours of written notification by the Project Manager will be cause for the Department to have the work performed. Costs incurred by the Department associated with application of blotter material will be deducted from subsequent progress estimates.

409.04 METHOD OF MEASUREMENT**409.04.1 Bituminous Material**

Bituminous material used for seal coat work is measured by the gallon (Liter) or by the ton (metric ton) under Subsection 402.04.

409.04.2 Cover Aggregate

Aggregate for "Cover - Type I" and aggregate for "Cover - Type II" is measured by the square yard (square meter), based on the length and width of seal coat placed and accepted.

409.04.3 Fog Seal

Bituminous material used for fog seal is measured by the gallon (liter) or by the ton (metric ton) under Subsection 402.04

409.04.4 Traffic Control

Traffic control is measured under Subsection 618.04.

409.04.5 Rolling

Rolling is not measured for payment.

409.04.6 Sweeping and Brooming

Sweeping and brooming and the disposal of excess material are not measured for payment.

409.04.7 Water

Water used for dust control or wetting chips is not measured for payment.

409.04.8 Blotter Material

Blotter material is not measured for payment.

409.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

Pay Item

Bituminous Material
Cover - Type I
Cover - Type II
Traffic Control

Pay Unit

Gallon (liter) or Ton (metric ton)
Square Yard (square meter)
Square Yard (square meter)
See Subsection 618.05

Payment at the contract unit price is full compensation for all necessary resources to complete the item of work under the contract.

409.05.1 Excess Crushed Cover Aggregate

Sale of excess crushed cover aggregate is the Contractor's option. The Contractor cannot sell material from Department-owned or Department-optioned sources without a written agreement establishing and providing royalty refunds to the Department.

The Department may purchase acceptable unused crushed cover aggregate remaining in the stockpile, if the quantity exceeds 100 tons (100 metric tons). The conditions of purchase are described in Subsection 109.07.

Haul from the stockpile site to the site selected by the Project Manager will be by the most practical route as determined by the Project Manager. Payment for haul is 15 cents per ton-mile (0.907 mt per 1.6 km) for distances exceeding 2,000 feet (610 m).

SECTION 410 BITUMINOUS SURFACE TREATMENT

410.01 DESCRIPTION

This work is applying one or more coats of bituminous material on a prepared aggregate roadway surface, covering each application with aggregate surfacing material.

410.02 MATERIALS

410.02.1 Bituminous Material

Furnish the specified bituminous material under Section 702.

410.02.2 Aggregate

Furnish the specified aggregate under Section 701.

410.03 CONSTRUCTION REQUIREMENTS

410.03.1 Equipment

Maintain the following equipment on the project throughout the work.

- A. Distributor.** One pressure distributor for bituminous material with a minimum 1,000-gallon (3785 L) capacity insulated tank, internally heated.

Equip the distributor with a full-circulating spray bar:

1. At least 9-feet (2.8 m) long;
2. Capable of 1-foot (305 mm) incremental length adjustments up to 16 feet (4.9 m);
3. Having vertical nozzle adjustment that conforms to the roadway crown;
4. Capable of lateral shifting of the entire spray bar while operating; and
5. With vertical height adjustment capable of maintaining a preset height above the road surface.

Use spray bars and flat-slotted nozzles designed to not clog during intermittent operation and provide positive cutoff of the bituminous material. Use positive-acting flow control valves to produce a uniform, unbroken spread of bituminous material.

Remove or repair distributors not uniformly distributing the bituminous material.

Assure the distributor has devices and charts to provide for accurate, rapid determination and quantity control of the bituminous material application.

Equip the distributor with a pressure pump, pressure gauge, thermometer well, thermometer, and a calibrated fluid content gauge.

Use pneumatic-tired distributors meeting legal load requirements.

- B. Rollers.** Furnish pneumatic tired rollers under Subsection 210.03.4(D).

- C. Aggregate Spreader.** Provide one self-propelled aggregate spreader:

1. Equipped with at least four pneumatic tired wheels on two axles;
2. Capable of uniformly spreading the material over the full width of the bituminous material; and
3. The spreader application rate being independent of motive power.

- D. Cleaning Equipment.** Use power brooms, blowers, or hand brooms.

- E. Watering Stockpiles.** Provide equipment for wetting the cover aggregate stockpiles, when required.

- F. Watering Equipment.** Furnish water-distributing equipment meeting the applicable requirements of Subsection 210.03.5.

- G. Scales.** Furnish scales under Subsection 301.03.2(C).

410.03.2 Existing Surface Preparation

Unless surface preparation is included in the contract surfacing item, perform the work under Section 204, as modified or supplemented below.

When required, apply a light, uniform water application to the roadway surface just before applying the bituminous material. Do not exceed 3 percent moisture by weight in the top 2 inches (50 mm) of the aggregate course.

When required, apply a prime coat of bituminous material at the rate directed before the initial application of bituminous surface treatment. Apply the prime coat under Section 407.

410.03.3 Sweeping

Clean the roadway surface of all dust, dirt, and foreign material before applying the bituminous material.

410.03.4 Application of Bituminous Material

Apply the bituminous material with a maximum allowable variation of 0.02 gallon per square yard (0.4 L per square meter) from the specified application rate.

Apply bituminous material only with the Project Manager's approval. Apply the material when the surface temperature is at or above 60 °F (16 °C).

Do not work when rain, wind, or temperatures would prevent obtaining the specified results.

Uniformly apply the bituminous material at the temperature and rate specified. Provide uniform surface cover and true lines.

Assure high viscosity bituminous materials are covered with aggregate within 5 minutes.

Apply bituminous material to produce smooth and consistent transverse and longitudinal joints in successive applications with the adjacent completed surfaces.

Longitudinal joints may be from 6 to 10 inches (150 to 255 mm) wide but not overlap at the application ends. Prevent lapping at transverse joints by inserting a drip pan under the nozzles if necessary. Before continuing the application, spread protective sheets over the treated surface on the cover aggregate to provide bituminous coverage at the joint.

Apply the material to keep meet lines to a minimum.

The Project Manager may approve full width application of bituminous material and cover aggregate in a single, continuous operation.

Re-apply bituminous material at joints where the uncovered bituminous material has set and does not bond the aggregate at Contractor expense.

410.03.5 Application of Cover Aggregate

When directed, water the stockpiled cover aggregate before spreading it on the bituminous material.

Cover the first bituminous material application within 60 minutes. Uniformly cover all bituminous material with cover aggregate at the specified rate. When directed, use brooms to uniformly distribute the cover aggregate. Avoid displacement or loosening of the cover aggregate.

Do not permit haul trucks and traffic to drive on any uncovered bituminous material. Furnish traffic control for fresh spread cover aggregate areas as specified in the traffic control plan.

Before applying the adjacent bituminous material, broom all joints the full width to remove loose aggregate.

410.03.6 Rolling

Roll the cover aggregate immediately after spreading within 30 minutes of spreading.

Use self-propelled pneumatic-tired rollers with a ground contact pressure of between 50 psi (345 kPa) and 95 psi (656 kPa). Provide two rollers for each aggregate spreader used.

Roll parallel to the centerline, starting on the low side of the lane and working towards the crown or high side. Overlap roller passes at least 6 inches (155 mm).

Continue rolling until a smooth, compacted surface is produced.

Avoid displacing or loosening the cover material while rolling.

410.03.7 Curing and Cleaning

When the rolling is completed on each surface course and the surface is accepted, it may be opened to traffic.

Allow the surface to cure for at least five days.

Repair all surface defects in the treated surface immediately with the specified bituminous material or use a pre-mix bituminous aggregate at Contractor expense.

Cover areas of excess bituminous material with aggregate and roll at Contractor expense.

When the Project Manager determines the first course of bituminous material and cover aggregate has cured and set, all repairs have been accepted, all excess cover aggregate is removed, clean the surface of dirt, dust, and foreign materials.

Begin construction of the succeeding course on the cleaned surface.

410.03.8 Completion

When the final course is complete, open the surface to traffic for three days, using the specified traffic control. During this time, broom and roll the surface as required.

Repair all surface defects under Subsection 410.03.7.

Cover all areas exhibiting excess bituminous material with aggregate and roll it.

410.03.9 Protection of Traffic and Highway Structures

A. Traffic Control. Furnish traffic control meeting the contract requirements and Section 618.

B. Structure Protection. Cover exposed bridge elements, culverts, curbs, gutters, guard fences, road signs, and other roadside structures to protect them from splash or spray when applying bituminous material.

Clean these same items of all bituminous material, dirt, or other material caused by the Contractor's operations.

Repair all Contractor caused damage to the highway or structures at Contractor expense.

410.04 METHOD OF MEASUREMENT

410.04.1 Bituminous Material

Bituminous material is measured by the gallon (Liter) or the ton (metric ton) under Subsection 402.04.

410.04.2 Cover Aggregate

Cover aggregate is measured by the ton (metric ton) or the cubic yard (cubic meter) measured in the vehicle at the point of delivery on the roadway, as specified in the contract and under Subsection 301.04.1.

410.04.3 Traffic Control

Traffic control is measured under Subsection 618.04.

410.04.4 Existing Surface Preparation

Where base construction is a part of the contract with bituminous surface treatment, the items of work for existing surface preparation are incidental to and included in payment for the base construction.

Where bituminous surface treatment is applied to an existing aggregate surface, the work for existing surface preparation is measured for payment under Subsection 204.04.

410.04.5 Rolling and Watering

Rolling and watering are incidental to other items of the contract and not measured for payment.

410.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

<u>Pay Item</u>	<u>Pay Unit</u>
Bituminous Material	Gallon (liter) or Ton (metric ton)
Cover Aggregate	Cubic Yard (cubic meter) or Ton (metric ton)
Traffic Control	See Subsection 618.05

Surface sweeping or cleaning, watering of aggregate stockpiles and the roadway surface, repairing damaged surfaces or surfaces with excess bituminous material, and protection and repair of structures specified in Subsection 410.03.9 are incidental to and included in payment for other items of the contract.

410.05.1 Existing Surface Preparation

Existing surface preparation, when specified, is paid for under Subsection 204.05.

When not specified in the contract, the existing surface preparation work is incidental to and included in the payment for the base construction.

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work under the contract.

SECTION 411 COLD MILLING

411.01 DESCRIPTION

This work is the removal of existing bituminous pavement at the locations specified in the contract or designated by the Engineer.

411.02 RESERVED

411.03 CONSTRUCTION REQUIREMENTS

411.03.1 Equipment

Use a power-operated cold milling machine equipped to control cross slope and to establish profile grade from the existing pavement or an external reference.

Use cold milling machines having a minimum single pass cutting width of 12 feet (3.7 m) where one or more full lanes are designated for removal except for the following conditions:

1. Cattle guards and bridge ends; or
2. Two-lane two-way roads 40 feet (12.2 m) in width or less where the total removal is less than 25,000 square yards (20,900 square meters).

Equip the milling machine to capture milling related dust.

411.03.2 General

Do not start cold milling until the plant mix material is available.

Remove all thin delaminated or loose layers of existing pavement left after cold milling.

Replace the milled pavement at bridge ends and cattle guards with new bituminous surfacing the same day leaving no transverse joints in the milled areas.

If new surfacing cannot be placed on the milled area the same day of the milling, taper the edges at structures and cattle guards at 50:1 with hot mix. Remove and dispose of the tapers immediately before placing the planned overlay on the milled area.

Replace all other areas designated for milling with new plant mix surfacing within 24 hours after the milling is performed.

Replacing existing pavement is a separate operation from any succeeding overlay or lift.

411.03.3 Milling

A. Bridge and Cattle Guard Approaches and Bridge Decks. Mill the existing bituminous surfacing from bridge decks, bridge approaches, and cattle guards at the locations specified in the contract.

Mill to the plan depth from the bridge ends out to a maximum 50 feet (15.3 m) from the bridge end. Taper the mill depth from that point to the level of the existing pavement surface from a minimum 10 feet (3 m) to a maximum 150 feet (45.8 m), as directed.

At cattle guards, the full depth milling distance varies from 0 to 40 feet (12.2 m), and the taper milling distance varies from 10 feet to 80 feet (3 m to 24.4 m), as directed.

Bridge deck mill depth is shown in the contract.

B. Milling at Other Designated Areas. Mill the existing pavement at the locations, widths and depths specified. Depths specified are minimums. The depth is measured below the existing pavement plane projected from points on un-distorted pavement near the centerline and the edge of the driving lane.

C. Cold Milling for Seal and Cover. Meet the following requirements when seal and cover goes directly on the cold mill surface:

1. Use a cold milling cutting head having a maximum 1/4-inch (6 mm) tooth spacing.

2. Equip the milling machine with automatic controls and sensors on both sides to maintain the specified grade and transverse slope.
3. Do not operate the milling machine in excess of 75 feet/minute (23 meters/minute) unless it can be demonstrated to the Project Manager that the milled surface can meet the plant mix overlay surface tolerance specified in Subsection 401.03.14.
4. Do not begin placing the seal and cover until all cold millwork is complete.

411.03.4 Salvage of Pavement Millings

Salvage, haul, and stockpile the milled pavement to the specified site.

Milled pavement is the Contractor's property when specified and must be removed from the project.

411.03.5 Replacing Removed Pavement

Pave all milled areas in the contract with the specified bituminous mixture, placed to the specified depth.

Grades will be provided at 50-foot (15.3 m) intervals for placing the new pavement for 250 feet (76.3 m) from each bridge end and 100 feet (30.5 m) from cattle guards. Set a wire line for grade control with intermediate supports to prevent wire deflection exceeding 0.015 feet (5 mm). Stop paving if the deflection exceeds 0.015 feet (5 mm) and make appropriate corrections.

Apply a tack coat on all milled areas before paving.

411.03.6 Traffic Control

Furnish traffic control under Section 618.

411.04 METHOD OF MEASUREMENT

Cold milling is measured by the square yard (square meter) of pavement removed to the specified depth.

411.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

<u>Pay Item</u>	<u>Pay Unit</u>
Cold Milling	Square Yard (square meter)

Payment at the contract unit price is full compensation for all necessary resources to complete the item of work under the contract.

The contract unit price may be adjusted if the Project Manager issues a written order to increase or decrease the milling depth.